VEHICLE ENGINEERING

	Presenter:
	Organization/Date: Orbiter/02-27-01

• **ORBITER**	**To Be Presented**
• **SOFTWARE**	**No Constraints**
• **FCE**	**No Constraints**
• **GFE**	**No Constraints**
• **FLIGHT READINESS STATEMENT**	**To Be Presented**
• **BACKUP**	

STS-102
FLIGHT READINESS REVIEW

February 27, 2001

Orbiter

AGENDA

Presenter:

Organization/Date:
Orbiter/02-27-01

- Engineering Readiness Assessment

• Previous Flight Anomalies	To Be Presented
• Critical Process Changes	To Be Presented
• Engineering Requirement Changes	No Constraints
• Configuration Changes and Certification Status	To Be Presented
• Mission Kit Status	No Constraints
• Safety, Reliability and Quality Assessment	No Constraints
• Special Topics	None
• Flight Readiness Statement	To Be Presented

- Backup Information

	Presenter:
	Organization/Date: Orbiter/02-27-01

PREVIOUS FLIGHT ANOMALIES

	Presenter:
	Organization/Date: Orbiter/02-27-01

STS-98
IN-FLIGHT ANOMALIES

PREVIOUS IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

STS-98 In-Flight Anomalies, Previous Shuttle Mission:

- 1 Orbiter problem identified
  - STS-98-V-01: LH2 Engine 1 Prevalve (PV4) Open Position Indicator B Failed Off
  - Details presented on following pages

All Anomalies and Funnies Have Been Reviewed and None Constrain STS-102 Flight

STS-98-V-01: LH2 Engine 1 Prevalve (PV4) Open Position Indicator B Failed Off	Presenter: Doug White Organization/Date: Orbiter/02-27-01

Observation:

- MPS LH2 Prevalve Open Indicator B failed off intermittently during ascent and following LH2 dump

Concern:

- Loss of both open A and B during prevalve opening (T-9.5 seconds) prior to SSME start will result in RSLS scrub at T-7 seconds
  - LCC RSLS-01

Discussion:

- Failure history for this valve shows two previous occurrences of dropouts
  - Flow 10 - 0.2 sec dropout
  - Flow 17 - 1.8 and 0.8 sec dropouts
  - Both failures were closed as UAs with the most probable cause being personnel in the area

STS-98-V-01: LH2 Engine 1 Prevalve (PV4) Open Position Indicator B Failed Off	Presenter: Doug White Organization/Date: Orbiter/02-27-01

Actions To Be Taken:

- Troubleshooting will involve connector, wire, and MDM verification
- If required, changeout of the position indicator will be accomplished by replacing the prevalve actuator (LRU)

Acceptable for STS-102 Flight:

- OV-103 has no history of intermittent LH2 prevalve open indications
- OMRS verification accomplished prior to and during propellant loading
- LCCs will preclude Crit 1R2 failure if open indicator fails on prior to T-31 seconds
- LCC will allow launch even if 1 of 2 open indicators fails off after prevalve is commanded open for SSME start

	Presenter:
	Organization/Date: Orbiter/02-27-01

STS-92
IN-FLIGHT ANOMALIES

PREVIOUS IN-FLIGHT ANOMALIES	Presenter: Doug White Organization/Date: Orbiter/02-27-01

STS-92 In-Flight Anomalies, Previous OV-103 Mission:

- 6 Orbiter problems identified
  - STS-92-V-01: Ku-Band System Failed
  - STS-92-V-02: ODS Centerline Camera Misalignment
  - STS-92-V-04: WSB 3 Vent Nozzle B Heater Erratic
  - STS-92-V-05: WSB 2 Vent Nozzle A Heater Failure
  - STS-92-V-06: FES Shutdown on Primary B Controller
  - STS-92-V-07: Dedicated Signal Conditioner Module Failure
  - Details are in Backup Section

All Anomalies and Funnies Have Been Reviewed and None Constrain STS-102 Flight

STS-97/4A ANOMALY: UNKNOWN MATERIAL FOUND IN WCS/URINAL

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

Observation:

- STS-97/4A post-flight WCS inspection revealed unknown material in WCS liquid flow path
- Significant blockage of WCS fan separator pitot tube

Concerns:

- Contamination/blockage of WCS components could result in loss of WCS function or ability to dump waste water.

Discussion:

- ISS flights require orbiter condensate separation (minimize waste dumps)
- STS-97/4A was the first flight of the Shuttle Urine Pretreat Assembly (SUPA) to minimize urine solids precipitation from concentrated urine

STS-97/4A ANOMALY: UNKNOWN MATERIAL FOUND IN WCS/URINAL

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

Actions Taken:

- Chemical analysis of STS-97 unknown material still in-work
  - Very inert organic material, mixture of several compounds
  - Investigation continuing to identify compounds, source of compounds and formation mechanism

Risk Assessment/Acceptable for STS-102/5A.1:

- Problem coincident with first use of SUPA modification
- SUPA/condensate separation systems will not be used on STS-102/5A.1
  - No proven method to prevent formation of unknown material
  - SUPA hoses and condensate separation system will remain on-board
- Lack of ability to separate condensate water will result in increased waste water dumps while docked with ISS
  - Original plan: one 40 lb waste water dump (estimate)
  - New plan: two waste dumps required, totaling 210 lbs (estimate)
- In-flight procedures exist for WCS urine collection failure

	Presenter:
	Organization/Date: Orbiter/02-27-01

CRITICAL PROCESS CHANGES

STS-102 CRITICAL PROCESS CHANGE REVIEW SUMMARY

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

Item Reviewed	No. of Items Reviewed	Period or Effectivity Covered	No. Found To Be Critical Process Changes
OMRSD Changes (RCNs)	0	STS-102 Specific & Non-Flight Specific Changes Approved 11/25/00 – 1/25/01	0
OMRSD Waivers & Exceptions	8	STS-102 Specific	0
IDMRD Changes (MCNs)	7	Approved 11/25/00-1/25/01	1
IDMRD Waivers & Exceptions	3	Approved 11/25/00-1/25/01	0
EDCPs	6	Closed 11/25/00-1/25/01	0
Boeing Specifications	54	Released 11/25/00-1/25/01	2
Boeing Drawings	448	Released 11/25/00-1/25/01	0
Material Review	316	Approved 11/25/00-1/25/01	0

- All process changes were reviewed and none constrain STS-102

CRITICAL PROCESS CHANGES

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

IDMRD MCN OM2952, 3-Way Solenoid Valve Updates

- This MCN updated the IDMRD to authorize use of revised ATPs, RSC-A-0055 and RSC-A0056
- ATP revision includes steps to adjust pressure to prevent moisture intrusion into the valve, to isolate leak test points, to specify that all recorded test data readings come from specific panel in the test set-up.

CRITICAL PROCESS CHANGES

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

Boeing Specifications:

MB0120-039 rev G, Thixotropic Filling Compound for use from –250 to 400F

- This specification provides for low density honeycomb core and honeycomb edge filling compound.
- The specification update was required to identify a new curing agent that has been qualified to replace obsolete agents.

MA0106-324 U03, Fabrication of Adhesive Bonded Structures:

- This process spec was updated to reflect the new curing agent identified in MB0102-039 rev G.

	Presenter:
	Organization/Date: Orbiter/02-27-01

CONFIGURATION CHANGES AND CERTIFICATION STATUS

CONFIGURATION CHANGES AND CERTIFICATION STATUS	Presenter: Doug White Organization/Date: Orbiter/02-27-01

15 Modifications Were Incorporated Along With 2 Certification Extensions During the STS-102 Processing Flow

- All required certification documentation have been submitted and approved
- All modifications have previously flown with the exception of:
  - 18755 LWTSA Cheater Bar Holder
  - 19381 MS Seat Back Tilt Lever Mod - Seats installed at Pad
- First flight all three Water Spray Boilers have been serviced with Propylene Glycol Monomethyl Ether (PGME)

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White

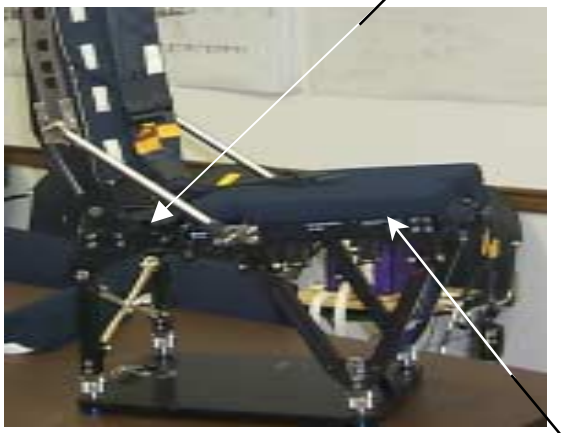
Organization/Date: Orbiter/02-27-01

- **Eliminates Vehicle/Crew Safety Concerns (Potential Inability To Reach Flight Controls If Seat Back Cannot Be Repositioned For Entry)**

- **Seat Back Angle Control Lever Moved From Right Rear To Right Front**
- **Inertia Reel Control Lever Moved From Right Front To Left Front**

- **Now Identical To LW CDR/PLT Seats (& HW Seats)**

New Configuration
Both Control Levers Easily Accessed At Front Corners



Old Configuration
Seat Back Control Was Difficult To Reach

	Presenter:
	Organization/Date: Orbiter/02-27-01

FLIGHT READINESS STATEMENT

SPACE SHUTTLE VEHICLE ENGINEERING OFFICE

STS-102 (OV-103) ☐ **ORR** ☒ **FRR** ☐ **Prelaunch MMT**

Pending completion of scheduled open work, the Orbiter vehicle, support hardware, flight crew equipment, and software are certified and ready to support. For United Space Alliance accountable functions, insight, audit, and surveillance activities have been reviewed, and there are no constraints to flight.

ORBITER / FLIGHT SOFTWARE / FLIGHT CREW EQUIPMENT

2-21-01
P. E. Shack, Manager, Shuttle Engineering Office

2/16/01
D. S. Rasco, Manager, Flight Crew Equipment Management Office

2/16/2001
D. E. Stamper, TMR, Software

2/23/01
L. P. Mulholland, TMR, Orbiter and Flight Crew Equipment

REMOTE MANIPULATOR SYSTEM

15 Feb 01
S. Higson, Program Director, SRMS McDonald Dettwiler and Advanced Robotics Limited

15-Feb-01
R. Allison, RMS Project Manager

SPACE VISION SYSTEM

for
L. Beach, Program Manager, SVS NEPTEC 9 Feb 01

2/15/01
D.S. Moyer, SVS Integration Office

FERRY FLIGHT PLANNING

2/16/01
D. L. McCormack, Ferry Flight Manager

Ralph R. Roe, Manager
Space Shuttle Vehicle Engineering

ORB-RRS 2

USA SSVEO Functions

STS-102 (OV-103) FLIGHT READINESS STATEMENT

☐ ORR ☒ FRR ☐ Prelaunch MMT

PENDING COMPLETION OF SCHEDULED OPEN WORK, THE ORBITER VEHICLE, SUPPORT HARDWARE, FLIGHT CREW EQUIPMENT, AND SOFTWARE ARE CERTIFIED AND READY TO SUPPORT.

ORBITER / FLIGHT SOFTWARE

Hoolehouse for GAR

G. A. Ray, Program Director, Orbiter
Reusable Space Systems
The Boeing Company

F. C. Littleton, Associate Program Manager
Orbiter Element
United Space Alliance

02/22/2001

T. F. Peterson, Associate Program Manager
Flight Software Element
United Space Alliance

FLIGHT CREW EQUIPMENT

02/22/01

E. L. Young, FCE/EVA Associate Program Manager
United Space Alliance

ORB-RRS 3

	Presenter:
	Organization/Date: Orbiter/02-27-01

BACKUP INFORMATION

	Presenter:
	Organization/Date: Orbiter/02-27-01

PREVIOUS IN-FLIGHT ANOMALIES

BACKUP

PREVIOUS IN-FLIGHT ANOMALIES

Presenter:

Organization/Date:
Orbiter/02-27-01

STS-97 In-Flight Anomalies, Previous Space Shuttle Mission:

- One problem identified
  - STS-97-V-01: Erroneous Vernier Thruster F5R Fuel Injector Temperature Readings
- Details provided on the following pages

The IFA was reviewed and does not constrain the STS-102 rollout

PREVIOUS SPACE SHUTTLE MISSION STS-97 IN-FLIGHT ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Observation:

- RCS Vernier Thruster F5R (S/N 106) fuel injector temperature sensor was off-scale high intermittently during STS-97

Concern:

- Potential loss of RM leak detection
  - Normal means for leak detection with loss of fuel injector temperature is to use the oxidizer temperature

Discussion:

- Vernier thruster F5R fuel injector temperatures diverged from oxidizer temperature periodically during the flight
  - Fuel injector temperature intermittently stayed off-scale high when oxidizer injector temperature cooled down
- Remained off-scale high from ISS undock to landing

PREVIOUS SPACE SHUTTLE MISSION STS-97 IN-FLIGHT ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion (cont):

- S/N 106 had only two flights since refurbishment (3593 pulses and 1405 seconds on-time for STS-99)
  - R&°R'd for coating chips in 1998
  - Temp sensors removed and reinstalled at WSTF
  - Reinstalled in F5R position prior to STS-99 and performed satisfactorily for that mission
- Possible Causes:
  - Most likely: Fuel temperature sensor failed
    - Electrical short or broken wire
  - Thermal grease anomaly
    - Fuel temperature divergence seen on STS-3 (no thermal grease) and STS-6 (dried thermal grease)
      - ΔT between fuel and oxidizer was ~30°F
  - DSC (OF2) or MDM (FF3)

PREVIOUS SPACE SHUTTLE MISSION STS-97 IN-FLIGHT ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Actions Taken:

- Troubleshooting performed on 12/21/2000 found resistance readings through the transducer legs on the FRCS side nominal
  - Using a decade box to simulate the sensor through the dedicated signal conditioner (DSC) OF2, no response was received indicating the problem is likely to be within the DSC
  - Additional troubleshooting will be performed

PREVIOUS SPACE SHUTTLE MISSION STS-97 IN-FLIGHT ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Acceptable for STS-102 OPF Rollout:

- Loss of fuel temperature sensor alone does not impact mission operations
  - Oxidizer temperature sensor provides leak detection for both valves
- Loss of oxidizer leak detection system due to erratic temperature indication is an isolated problem
  - Occurrence specific to OV-105 vehicle and has not been seen on OV-103 vernier thrusters
- Vernier thruster valves have demonstrated high reliability
  - Only one in-flight leak (STS-28)
- Additional workarounds are available should both temperature sensors fail

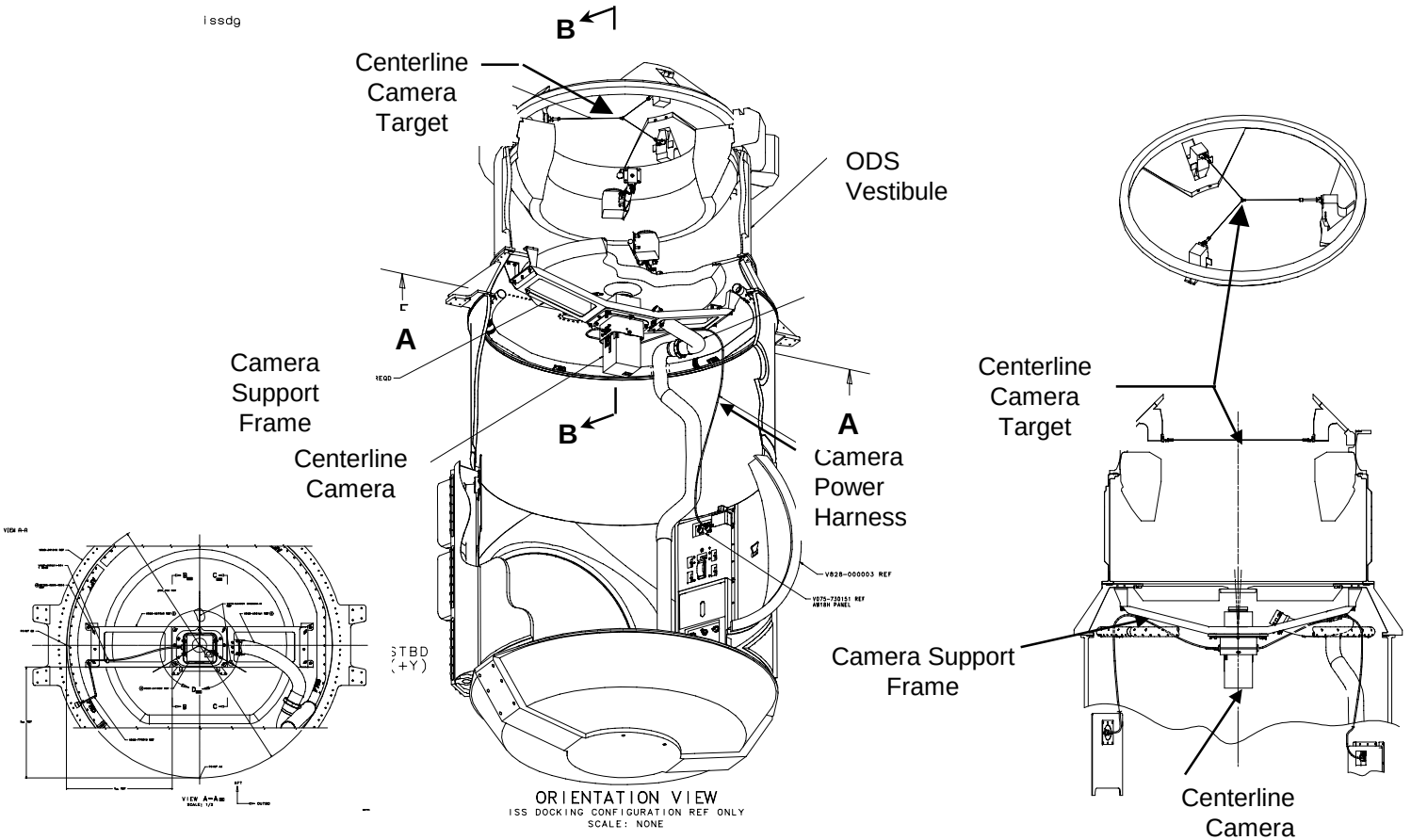
STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

BACKUP CHARTS

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT

Presenter:

Organization/Date:
Orbiter/02-27-01



View A-A

ODS Overview Showing Centerline Camera Components

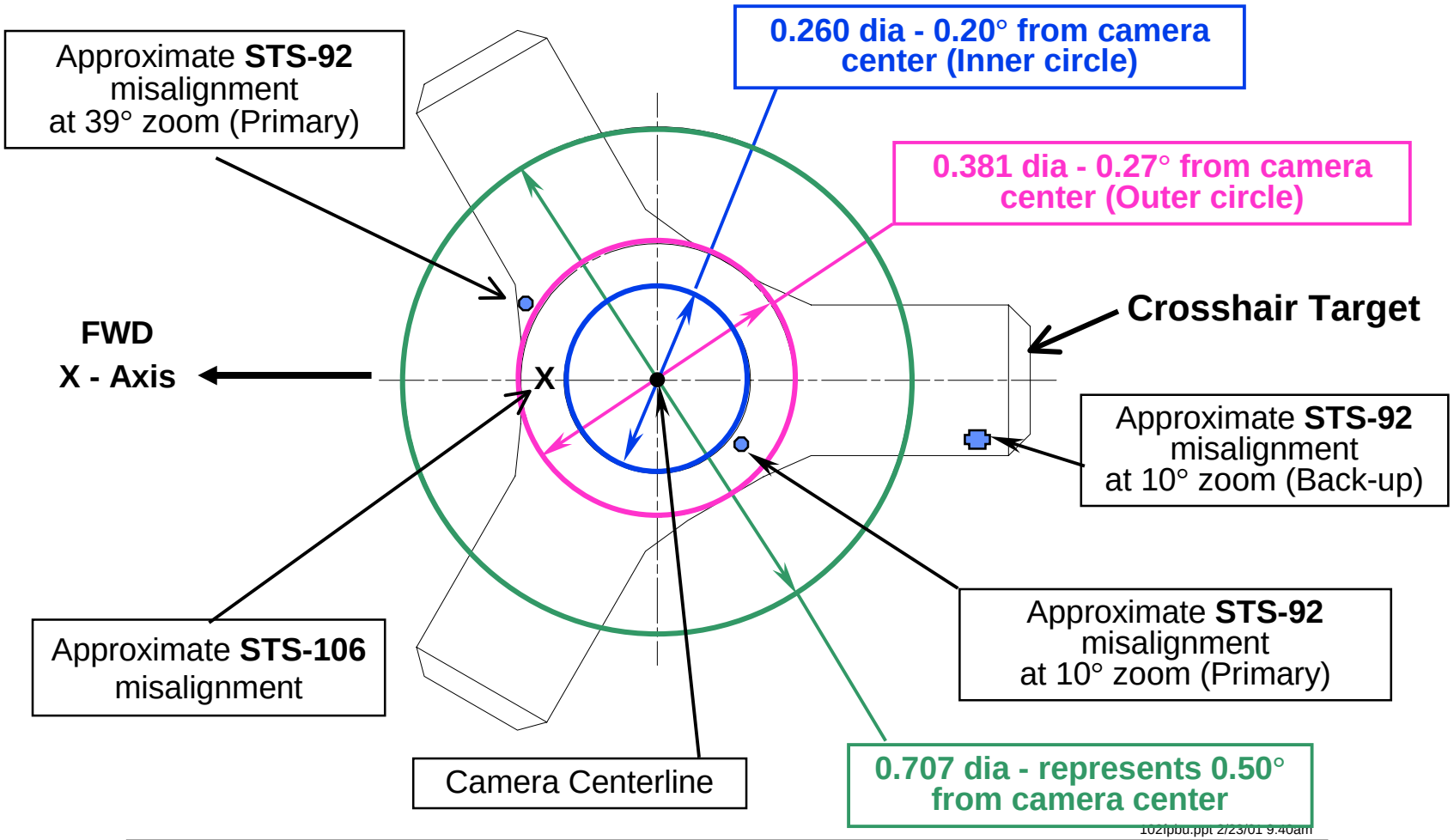
View B-B

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT

Presenter:

Organization/Date:
Orbiter/02-27-01

Target Detail View Showing STS-92 and STS-106 Misalignment



STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT

Presenter:

Organization/Date: Orbiter/02-27-01

Actions Taken: (Cont)

- **Review of flight history (11 of 15 Mir and ISS docking missions) shows small APAS misalignments at docking**

Misalignment / Flight	Delta X Translation (in.)	Delta Y Translation (in.)	Theta X Roll (degree)	Theta Y Pitch (degree)	Theta Z Yaw (degree)
STS-79	0	0	0	0.75	0.30
STS-81	0	0	-0.15	-0.30	0
STS-84	0	0	0	-0.80	0
STS-86	0.20	0	-1.25	-1.3	-1.40
STS-91	-0.08	-0.10	0.08	-0.20	0.10
STS-88	0.22	-0.04	-0.20	-0.50	-0.15
STS-96	-0.08	-0.08	0	0.75	1.40
STS-101	-0.08	-0.08	0.60	0.50	0.90
STS-106	-0.04	0.04	-0.10	0.50	0.60
STS-92	-0.08	0.08	-0.45	-0.50	0.08
STS-97	-0.08	-0.08	-0.60	-0.60	-0.30

- APAS capability provides significant margin to accommodate combination of actual docking misalignment and observed centerline camera misalignment
- Slight centerline camera misalignments like those observed during STS-106 and STS-92 had no significant effect on actual alignment at docking

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

Back Up Discussion:

- Misalignment to a similar degree was observed with the primary centerline camera during STS-106 (OV-104) in preparation for docking
- During STS-106 preparations for un-docking, the camera was reinstalled and was observed to be nominally aligned
- The backup camera was not used during STS-106

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

Actions Taken: (Cont)

- APAS procurement spec, certification test data and mission analysis indicate significantly higher misalignments can be tolerated
  - Misalignment capability per APAS Procurement Spec (JSC 26938)
    - Translational: 4.2 in (radial)
    - Angular: +/- 4.0° (each axis)
    - Rotational: +/- 4.0°
  - APAS certification, which included capture tests at extreme envelope tolerances, and every mission simulation analysis of ~1000 randomly generated 3 sigma cases for alignments and velocities has verified docking capability to these envelopes

	Presenter:
	Organization/Date: Orbiter/02-27-01

CONFIGURATION CHANGES AND CERTIFICATION STATUS

BACKUP

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/02-27-01

OV-103 STS-102 Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Current Mission Requirements 18212 UHF SPACE COMMUNICATION SYSTEM				N/A	N/A	• Screw change out due to meet thread protrusion requirement for the EVA Com antenna Ref EOTF V070-744009, COM-5-15-214 … Certification not required.
18755 WINDOW 9 FLIGHT COVERS			X	03-25-661611-001I Submitted 12/19/00	01/30/01	• Required bracket relocation due to MEDS interference; Crew request
18755 BOLT CHANGEOUT TO PIP PINS		X		02-25-660302-006A Submitted 10/25/00	11/16/00A	• Allow support struts to attach the emergency platform to the wall with use pip pins.
18775 ADVANCED MASTER EVENT CONTROLLLER (AMEC)		X	X	21-450-0016-0009 Submitted	02/21/00A	• Replaces obsolete MEC transparent fit and function; attrition mod
19263 WASTE COLLECTION SYSTEM (WCS) MOD FOR URINE PRETREAT	X	X	X	01-23-WCS1000A Submitted 10/19/00	11/28/00A	• Mod to reduce risk of waste system clogging due to urine solids, hardware provisions enable stowage of the replaceable oxone hose section
19268 EXTERNAL AIRLOCK CANOPY MODIFICATION-REMOVAL				N/A	N/A	• Certification not required; Partial removal of existing canopy hardware only

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/02-27-01

OV-103 STS-102 Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Current Mission Requirements (Cont.)						
19288 BASE HEAT SHIELD/DOME BUSHING REPAIR			X	114-03-351900-001G Submitted 11/07/00	11/15/00A	• Adds doublers to specific areas where guide pins are used and bushing repair
19381 LIGHT WEIGHT SEAT BACK MECHANISM		X	X	03-25-39126815-301B Submitted 11/27/00	01/19/01	• Mod due to difficulty in changing seat back angle from launch position to re-entry position
19470 FLEET WIRING ISSUE CORRECTION ACTION				N/A	N/A	• Additional wire protection was installed in the payload bay wire trays as part of the corrective actions from the fleet wiring investigation. •Components of wire & cable assemblies certified by Qual tests performed at component level ref: CR 21-77000H …. Certification not required
19477 SHUTTLE ARS MODIFICATION TO IMPROVE STATION AIR FOR CREW		X		12-35-643500-002M Submitted 10/04/00	01/26/01	• Relocation mod for the permanent solution to improve air quality to the space station.
19504 LANDING GEAR DOWN CIRCUIT REDESIGN			X	04-21-763340-001F Submitted 10/04/00	11/28/00A	• MOD TO REMOVE 3 CRITICALITY 1/1 CIL'S IN THE LANDING GEAR DOWN CIRCUIT.

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/02-27-01

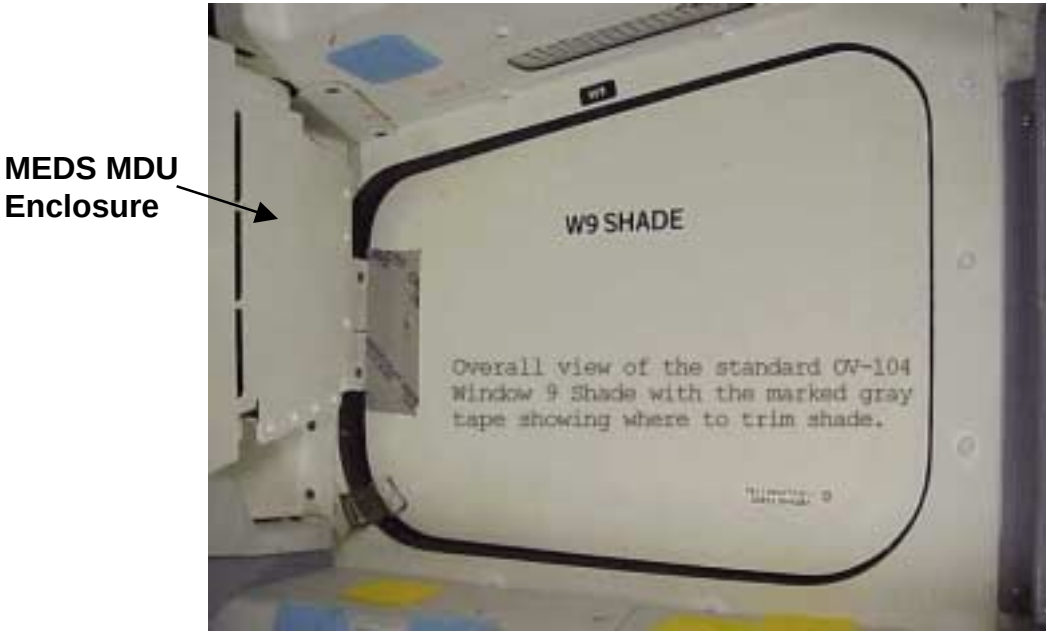
OV-103 STS-102 Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Current Mission Requirements (Cont.)						
19513 ORBITER/ET AFT ATTACH L-FITTING MODIFICATION		X		06-45-565201-001R Submitted 08/22/00	09/18/00A	• Provides "L" fittings to the aft attach ftg flange. Increased load fittings are easy to installed & can be inspected after each Flight.
19535 HEAT SHRINK-FIT TUBING FOR PYRO HARNESSES				N/A	N/A	• Improved safety, reliability, integrity & life of pyro harnesses by providing additional protection from wire damage through re-enforcing the areas located about and adjacent to saddle clamps; •Components of wire & cable assemblies are certified by Qual tests performed at component level Ref: CR 21-77000H …. Certification not required
23016 AFT FUSELAGE WIRE PROTECTION MODIFICATION				N/A	N/A	• Addition of Clamps and tape for protection of aft compartment wiring. REF EOTF OEL-5-15-2202; •Components of wire & cable assemblies are certified by Qual tests performed at component level Ref: CR 21-77000H …. Certification not required

CONFIGURATION CHANGES AND CERTIFICATION STATUS	Presenter:
	Organization/Date: Orbiter/02-27-01

Modified Window 9 Shades:

- Interference was found between the Window 9 Flight Shades and the monitor bracket for the MEDS MDU
- Modifies the Window 9 shade on all MEDS modified Orbiters
- Modified shades scheduled for delivery to KSC on 1/11/01



CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/02-27-01

Emergency Egress Platform Installation

Avionics Bay 3B

Fasteners at each of the strut attach points replaced by pip pins

Platform Support Struts - 3 Req'd

Center Strut

Emergency Egress Platform

<u>Middeck</u> - <u>View Looking Outboard at Side Hatch</u>

102fpbu.ppt 2/23/01 9:40am

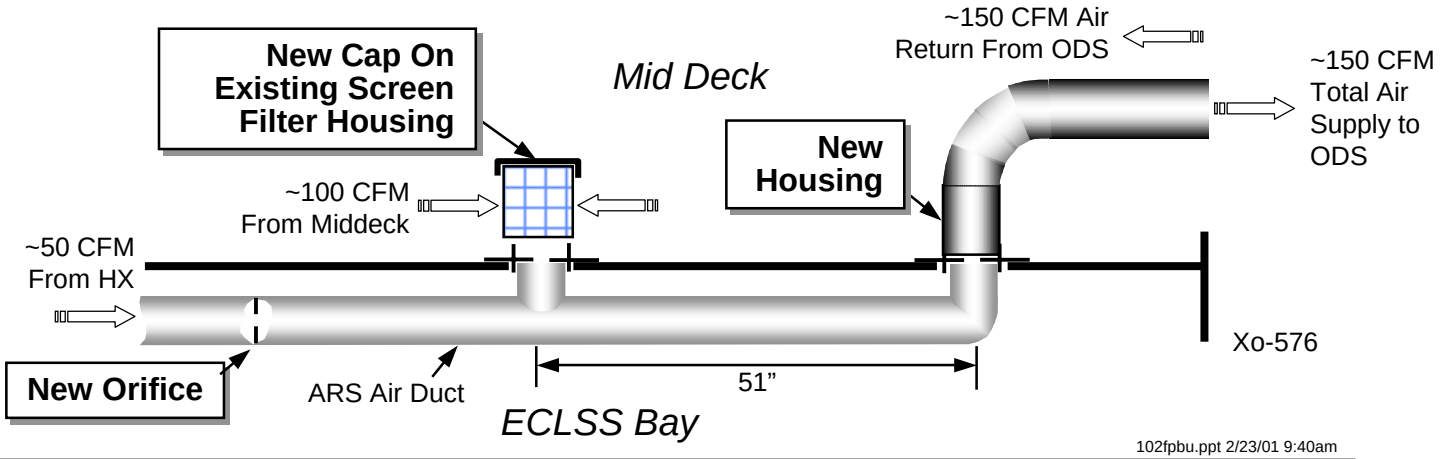
CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/02-27-01

Shuttle ARS Ducting Below the Floor:

- Previously OV-103 has flown an extended mid-deck floor to external airlock ARS duct configuration for improved ISS/Spacehab air quality
  - Crew installed duct was 51 inches longer and was routed above-the-floor to the forward mid-deck venturi location
- New (permanent) modification provides rerouted air flow below the mid-deck floor
  - Allows returning to the previously manifested shorter duct and connection to the aft venturi location



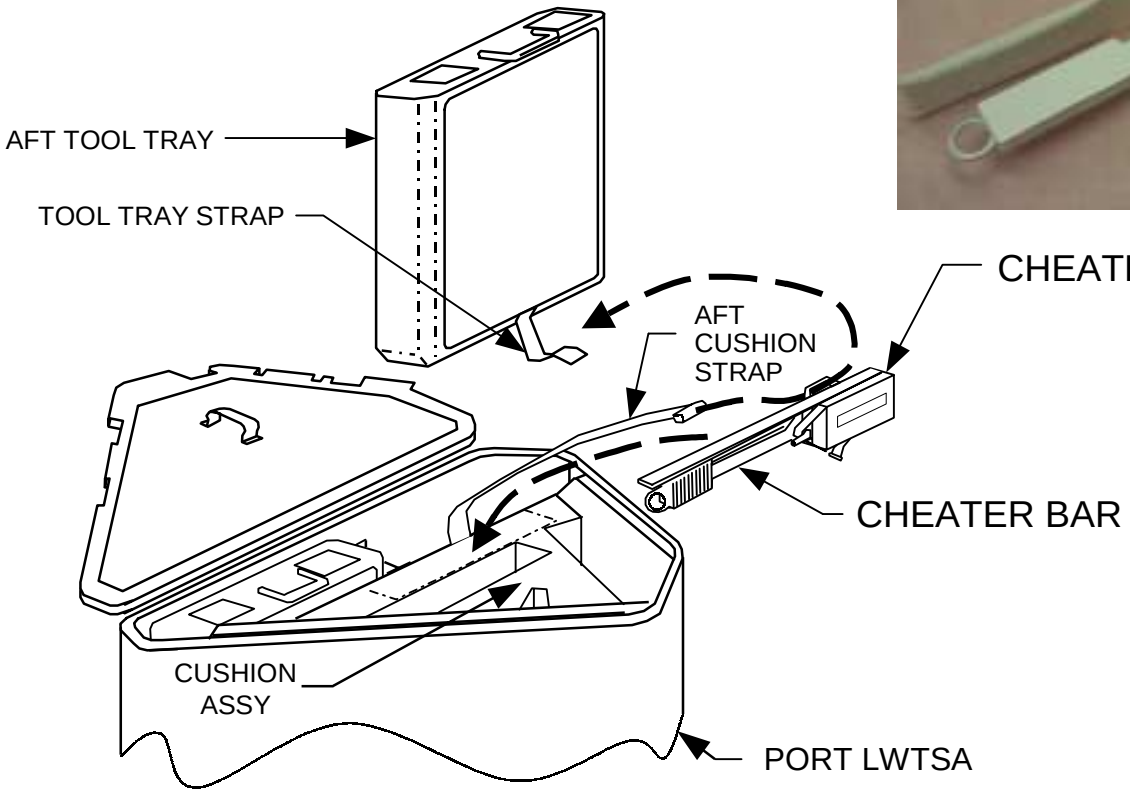
102fpbu.ppt 2/23/01 9:40am

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White

Organization/Date: Orbiter/02-27-01

- **Cheater Bar / Holder added to LW TSA**
- **Attaches to LW TSA Cushion Strap**
- **Integrated Cargo Carrier (ICC) contingency tool**



	Presenter:
	Organization/Date: Orbiter/02-27-01

MISSION KITS BACKUP

ORBITER PROVIDED MISSION KITS	Presenter:
	Organization/Date: Orbiter/02-27-01

Orbiter Provided Mission Kit Changes:

- MV0072P Payload GFE Mission equipment
- MV0076A Orbiter Docking Mechanism
- MV0082A Remote Manipulator System (RMS)
- MV0412A S-Band FM System
- MV0413A Centaur Structure (Scar installation)
- MV0426A MADS III
- MV0465A GN2 Instl
- MV0485A TACAN Cooling
- ✓ MV0494A GPS/INS DTO
  - M072-703113-003 MAGR-S only (no SIGI)
- MV0520A Payload Heat Rejection Unit (PLBD Rad)
- MV0525A PRSD T/S 4

✓ First Flight

ORBITER PROVIDED MISSION KITS	Presenter:
	Organization/Date: Orbiter/02-27-01

Orbiter Provided Mission Kit Changes:

- MV0529A Rendevous and Docking Floodlights
- MV0532A Payload Bay Liner
- MV0539A RTG Cooling (Scar)
- MV0544A PRSD T/S 3
- MV0548A Bulkhead CTVC
- MV0549A Payload Bay floodlights
- MV0557A Keel Camera Instl (Harness instl)
- MV0566A PRSD T/S 5
- MV0568A Provisions Stowage Assy (PSA)
- ✓ MV0573A Aft Ballast Assy
  - M072-851701-025 New config for 1640 lbs
- MV0617A EVA Slidewire

✓ First Flight

ORBITER PROVIDED MISSION KITS	Presenter:
	Organization/Date: Orbiter/02-27-01

Orbiter Provided Mission Kit Changes:

- MV0622A Payload Bay flag
- MV0643A MMU Orbiter provisions
- ✓ MV0828A External Airlock
  - M072-337828-003 Configuration for Egress platform mod
  - M072-343828-TBD Canopy mod (scar)
- ✓ MV0849A Tool Stowage Assy
  - M072-660851-007 Port TSA Tool config (Unique for STS-102)
- MV0864A Fiber Optic Connector (scar)
- MV0866A IVHM Instl (scar)

✓ First Flight

STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE

Presenter:

Organization/Date:
Orbiter/02-27-01

Observation:

- During payload bay door closure on STS-98 (OV-104), the mid-starboard payload bay floodlight #4 failed to turn on when commanded by crew
  - Current measurements of Main Bus C indicated RPC trip (approx. 14 amp excursion)
    - 10 amp RPC 7 in MPCA #3

Concern:

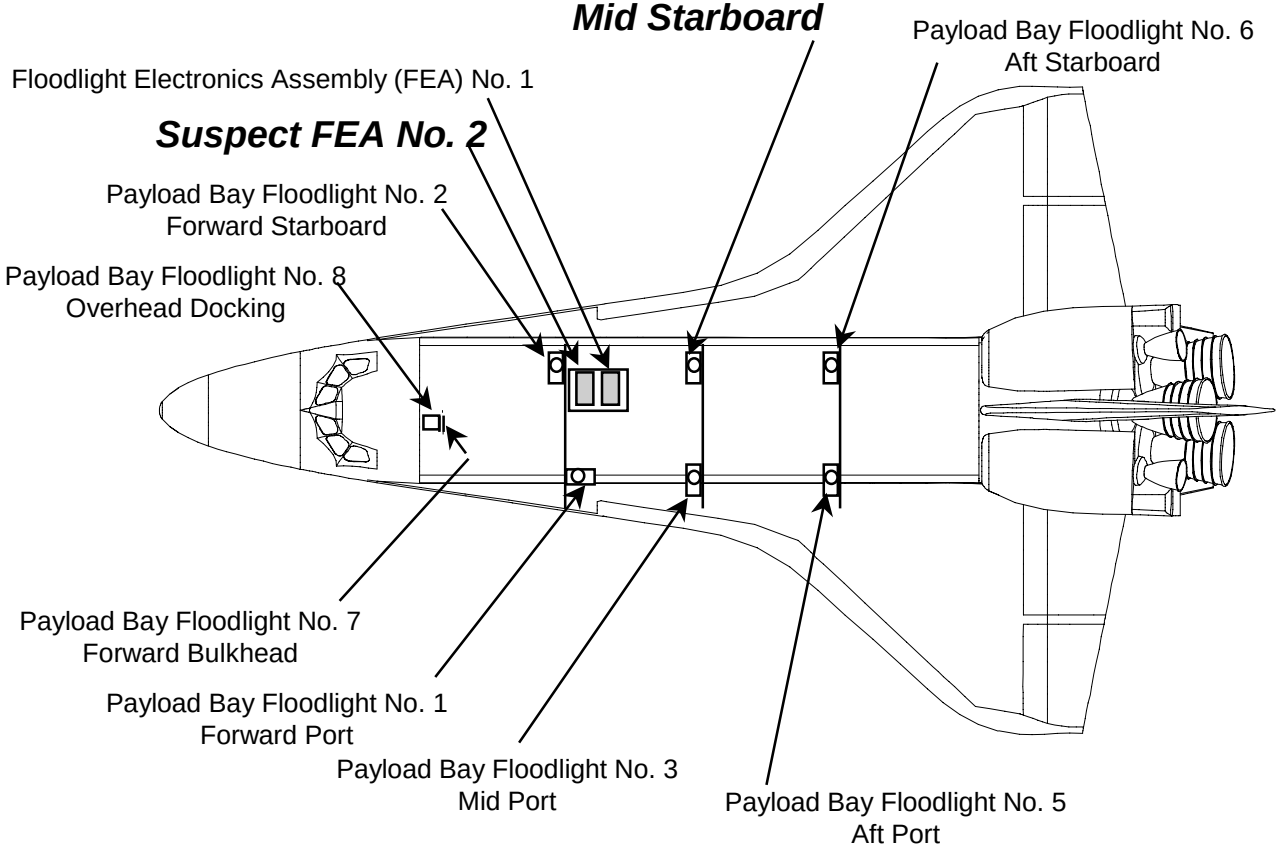
- Multiple loss of payload bay floodlights may impact mission success
  - Loss of lighting could cause crew to utilize alternate method (handheld spotlight) for verification of payload bay latch operation

STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE

Presenter:

Organization/Date:
Orbiter/02-27-01

Failed Payload Bay Floodlight No. 4
Mid Starboard



*Payload Bay Doors Not Shown

STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion:

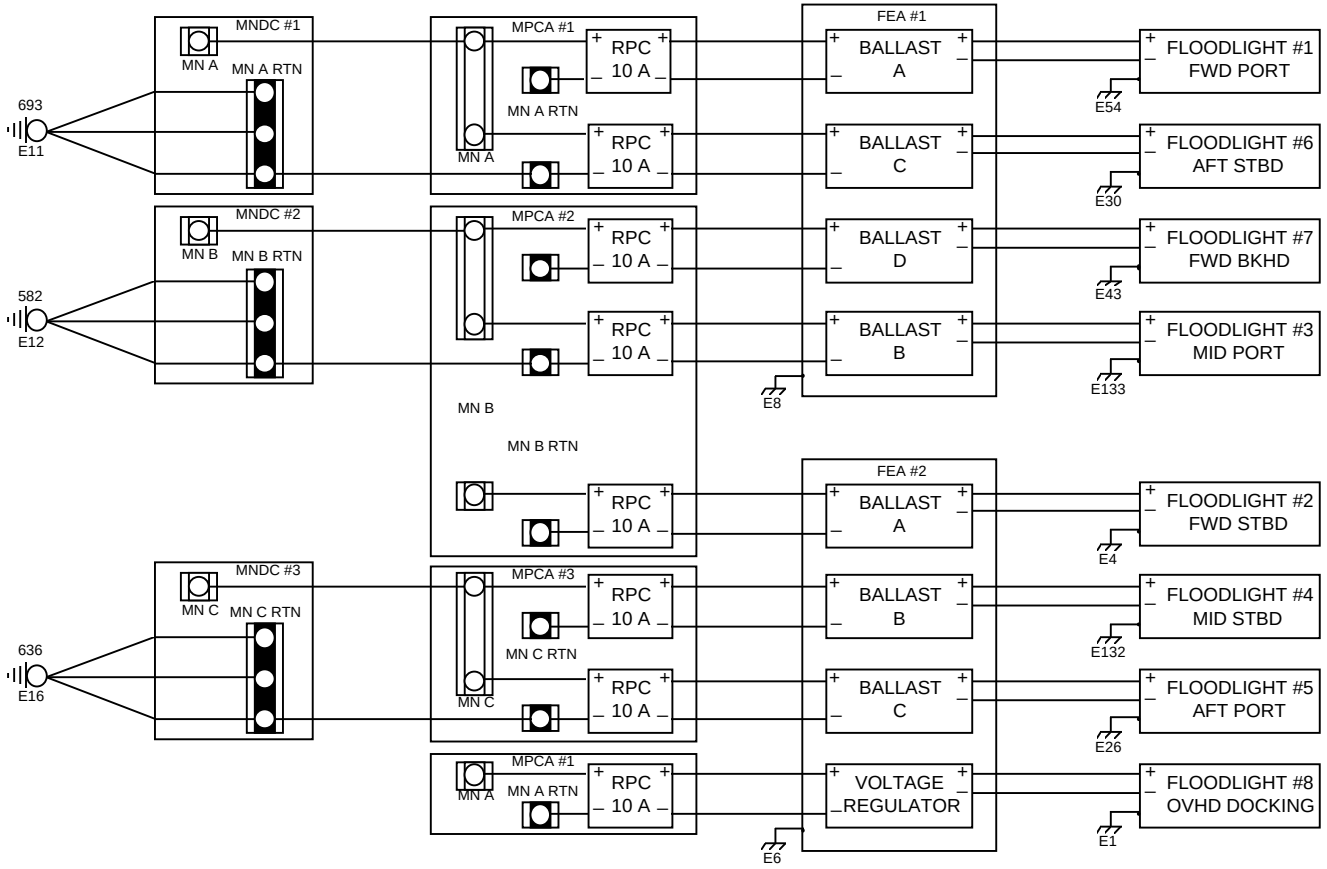
- OV-104 Floodlight Electronics Assemblies (FEAs) are modified and have a current output of 1.3 amps
- FEA #2 provides power to payload bay floodlight #4
- Main Bus C current measurements point to most probable cause for loss of floodlight #4 to be a failed ballast B in FEA #2
  - Another possible cause is corona arcing in floodlight assembly, however current signature is not consistent with arching
- FEA #2 was issued to OV-104 in 1996 in support of flight 16
  - FEA #2 has successfully supported 7 missions prior to STS-98

STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE

Presenter:

Organization/Date:
Orbiter/02-27-01

Overview of Payload Bay Floodlight System



STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (cont)

- FEA #2 contains 3 ballast assemblies and 1 voltage regulator
  - Each ballast assembly powers its own individual floodlight
  - Voltage regulator is used to power overhead docking floodlight
    - Failure of one ballast will not affect other ballasts or regulator
- Most likely component failure in ballast assembly is the transistor Q6
  - Failure of transistor Q6 is usually a collector to emitter short due to electrical overstress
    - Transformer T1 in ballast assembly may be a contributing factor to the overstress of transistor Q6
      - Transformer T1, due to a marginal design of its “fly-back” operation, tends to become saturated causing Q6 overstress

STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE	Presenter:
	Organization/Date: Orbiter/02-27-01

Risk Assessment:

- Payload bay floodlights are critically 2R/3
- Multiple loss of payload floodlights could impact mission success

Acceptable for STS-102 Flight:

- Adequate system redundancy exists
- Low probability of failure in ballast assembly with modified ballast
  - Last failure of a ballast assembly was in February 1998
- OV-103 payload bay floodlights have successfully passed OMRSD testing

	Presenter:
	Organization/Date: Orbiter/02-27-01

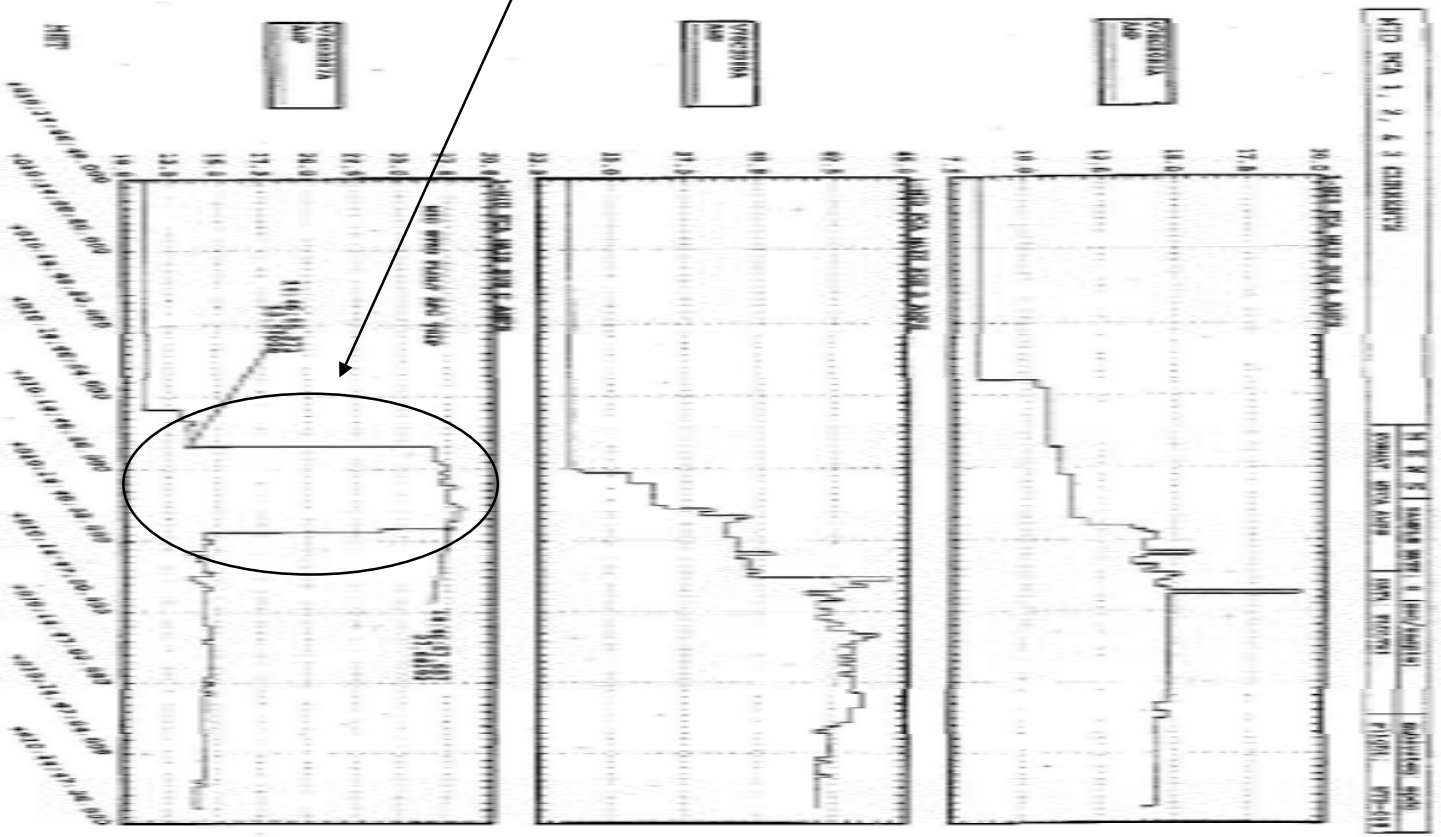
BACKUP

STS-98 MID-STARBOARD PAYLOAD BAY FLOODLIGHT FAILURE

Presenter:

Organization/Date:
Orbiter/02-27-01

Current Measurement showing RPC trip



STS-92-V-01: KU-BAND SYSTEM FAILED	Presenter:
	Organization/Date: Orbiter/02-27-01

Observation:

- During STS-92, OV-103's Ku-Band system did not operate in Comm or Radar mode

Concerns:

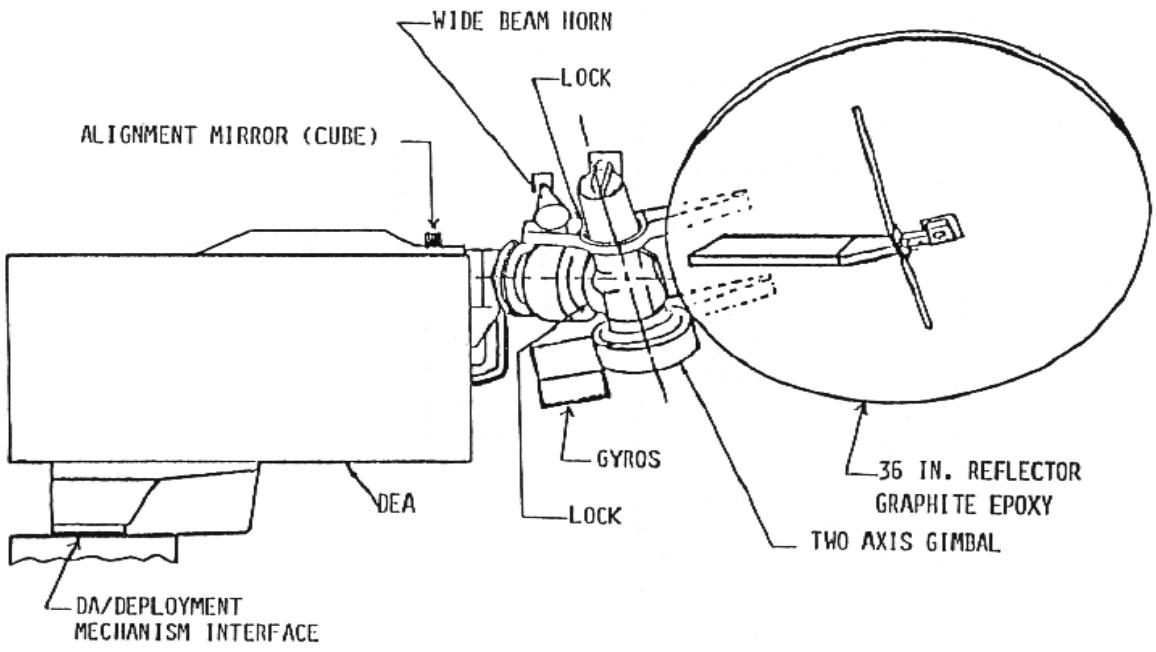
- Loss of Ku-Band Comm mode results in loss of real-time video and high data rate downlink capability
- Loss of Radar function requires utilization of workarounds for rendezvous and docking operations

Discussion:

- On-orbit troubleshooting (power cycles, self-tests, etc.) was unable to recover Ku-Band operation

STS-92-V-01: KU-BAND SYSTEM FAILED	Presenter:
	Organization/Date: Orbiter/02-27-01

Deployed Assembly (DA) Hardware Overview



STS-92-V-01: KU-BAND SYSTEM FAILED	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- Post-flight troubleshooting determined that the cause of problem was within the DEA Exciter circuitry
  - The Ku-Band DA (S/N 102; which includes the DEA) was removed on 11-20-00 and sent to NSLD for failure isolation and repair
    - Troubleshooting confirmed to the component level
      - Q5 transistor on the A3A1 Harmonic Phase Comparator Circuit Card was found to be bad
      - Transistor had an open Base-Emitter junction which prevented conduction and subsequently phase-lock within the DEA
    - Component was removed and replaced
    - DEA will undergo solder rework

STS-92-V-01: KU-BAND SYSTEM FAILED	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- A replacement Ku-Band DA (S/N 107) was installed and failed OMRSD testing due to frequency spurs (noise) observed in radar and communication mode frequencies
  - Spurs were consistent, observed after each power-up sequence and affected communication performance
    - Observed high bit error rate along with poor TV picture quality
  - Two of the five radar frequencies had spurs
    - Could affect radar performance on orbit
- Ku-Band DA (S/N 107) was removed and replaced with Ku-Band DA (S/N 108)
  - All OMRSD testing (S/N 108) has been completed successfully

STS-92-V-01: KU-BAND SYSTEM FAILED	Presenter:
	Organization/Date: Orbiter/02-27-01

Risk Assessment:

- The Ku-Band system is criticality 2/2 for the observed failure
- Workarounds are available to accomplish rendezvous or docking operations if Ku-Band radar mode is lost
  - Star Tracker, HUD, COAS, LIDAR (handheld), TCS
- Loss of Ku-Band Comm mode represents loss of high data rate and real-time video via TDRSS
  - There is no STS-102 requirement for high data rate downlink
  - S-Band can be utilized as backup to downlink real-time video when the Orbiter is over FM ground station
    - Use of S-Band system is more constrained with respect to vehicle attitude (e.g. when antennas are pointing towards Orbiter nose / tail)

STS-92-V-01: KU-BAND SYSTEM FAILED	Presenter:
	Organization/Date: Orbiter/02-27-01

Acceptable for Flight:

- Discrepant OV-103 Ku-Band system hardware has been removed and replaced with a flight spare
- Comm and radar workarounds are available
- All Ku-Band system OMRSD testing has been successfully completed

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

Observation:

- During preparation for docking the crew reported that the primary ODS C/L camera was misaligned
- The crew removed the primary camera and installed the backup camera, but the misalignment was worse
- The primary camera was reinstalled, docking was allowed to proceed and a successful capture was completed

Concern:

- Severe centerline camera misalignment could impact docking operations

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- STS-92 misalignment was observed prior to docking
  - Primary camera – marginal
  - Secondary camera – 0.4 inches
- System design requirement is for the camera installation to be within +/-0.25 inch in translation, +/-0.5° in combined pitch/roll and +/- 0.5° in yaw to the docking base centerline
- APAS procurement spec, certification test data and mission analysis indicate significantly higher misalignments can be tolerated
  - Translational: 4.2 in (radial)
  - Angular: +/- 4.0° (each axis)
  - Rotational: +/- 4.0°

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

Actions Taken:

- Evaluation of possible causes was defined utilizing fault tree analysis
- Testing on OV-104 was unable to re-create the anomaly
- Alignment testing on OV-103 was able to recreate the STS-92 flight misalignment
  - Problem traced to improper installation of the camera and/or crossbeam during original ground alignment pre-STS-92
    - Subsequent good installations on-orbit resulted in misalignment
  - Current alignment specification does not have specific requirements for proper camera installation verification
    - PRT evaluating updating the OMRSD and alignment specification
- For STS-102, both primary and backup cameras have been re-aligned using an updated TPS which included requirements to verify no gaps at the camera/crossbeam and crossbeam/airlock (8) interfaces

STS-92-V-02: ODS CENTERLINE CAMERA MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/02-27-01

Risk Assessment:

- Based on an assessment of APAS performance capabilities and previous mission docking alignment data, centerline camera misalignments on the order of those observed during STS-106 and STS-92 represent no risk to a successful docking

Acceptable for Flight:

- Realignment of cameras on OV-103 has been performed and confirmed that both the primary and backup centerline cameras are aligned within specification
- APAS performance capabilities can accommodate camera misalignment larger than that recently observed with no risk to a successful docking

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Observation:

- Water spray boiler (WSB) 2B steam vent nozzle heater dropped off-scale low (<122 ºF) during STS-92 pre-entry
- WSB 3B steam vent nozzle heater failed to operate during STS-92 pre-deorbit

Concern:

- Vent nozzle heater failure can cause the loss of WSB due to orifice icing/blockage

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Background:

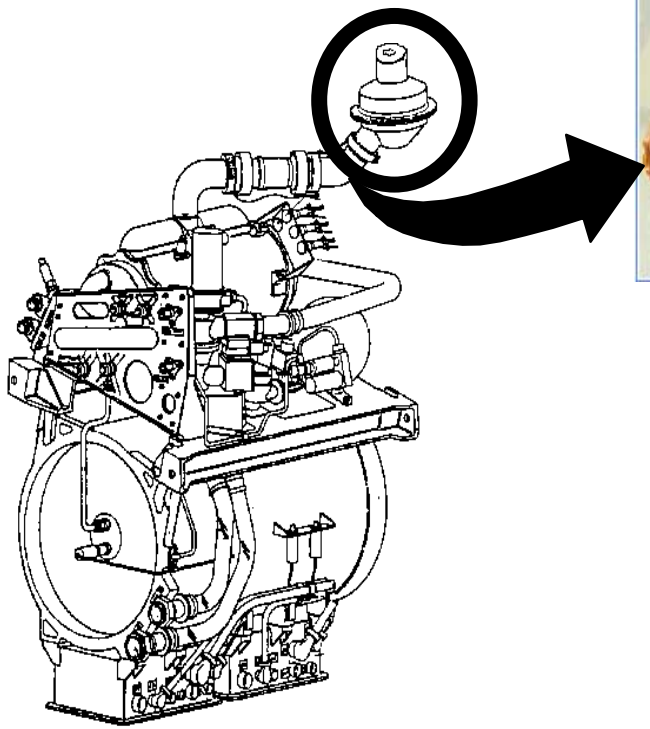
- WSB vent nozzle heaters are required to sublimate ice that forms on the vent nozzles after ascent shutdown to prevent orifice blockage/damage by maintaining vent nozzle housing temperature between 145 ºF and 180 ºF
- WSB vent nozzle consists of two independent coil heaters
  - Each heater has its own controller, temp sensor and wiring circuit
  - System “A” heater is typically used for ascent and “B” for entry

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES

Presenter:

Organization/Date:
Orbiter/02-27-01

Water Spray Boiler Assembly & Controllers



WSB Vent Nozzle Assembly

WSB Vent Nozzle Heater Coils A & B

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- Review of STS-92 flight data shows that both vent nozzle anomalies are due to vent nozzle heater failures
- Six previous flights experienced similar anomalies which were attributed to erratic cycling/heater braze joint failure
  - STS-61C, -41, -39, -43, -53 & -86
- In the existing design, heaters are not hermetically sealed, making the heater coil susceptible to corrosion/oxidation cracks at the braze joints
  - A design mod is in the process of being implemented to manufacture and procure hermetically sealed coil heaters (-004 configuration)
  - Both failed heater assemblies have been replaced
    - System #3 has the new hermetically sealed (-004) units

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Actions Taken:

- Long Range Fleet Implementation Plan
  - PRT has ordered a fleet supply of the –004 configuration to be installed on all vehicles
    - Estimated delivery dates:
      - 3 sets (6 heaters) – March 2001
      - 5 sets (10 heaters) – May 2001
      - 10 sets (20 heaters) – November 2001
  - Installations will be negotiated / coordinated with KSC flow management on a case by case basis

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Risk Assessment:

- LCC requires one of two vent nozzle heaters to be operational and one heater cycle prior launch
  - Individual system vent nozzle heater performance is verified 12 hours prior to liftoff when the heaters are turned on
- Vent nozzle heater failure during pre-launch/ascent results in loss of APU ready signal
  - Passive system - no blockage concern
- Loss of one vent nozzle heater during post-ascent or pre-entry would require switching to backup controller
  - Controllers are 1R3
  - Vent nozzle heater is checked-out and nozzle baked-out following FCS checkout
- Loss of both vent nozzle heaters during post-ascent/pre-entry would result in loss of one WSB (start at TAEM)
  - Safe entry with 2 of 3 WSBs - WSBs are 1R2

STS-92-V-04 & STS-92-V-05: WSB VENT NOZZLE HEATER ANOMALIES	Presenter:
	Organization/Date: Orbiter/02-27-01

Acceptable For Flight:

- Two of the three OV-103 vent nozzle heater assemblies have been replaced
  - System #3 has the new hermetically sealed units
- Each of OV-103's WSB systems passed OMRSD checkout during the STS-102 processing flow
  - Vent nozzle heater performance will again be verified when heaters are turned on prior to launch
- Each vent nozzle assembly has a fully redundant heater system

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Observation:

- FES shutdown in overtemp-rate-shutdown mode twice when operated in Prim B Full-Up mode during STS-92 de-orbit prep checkout activity

Concern:

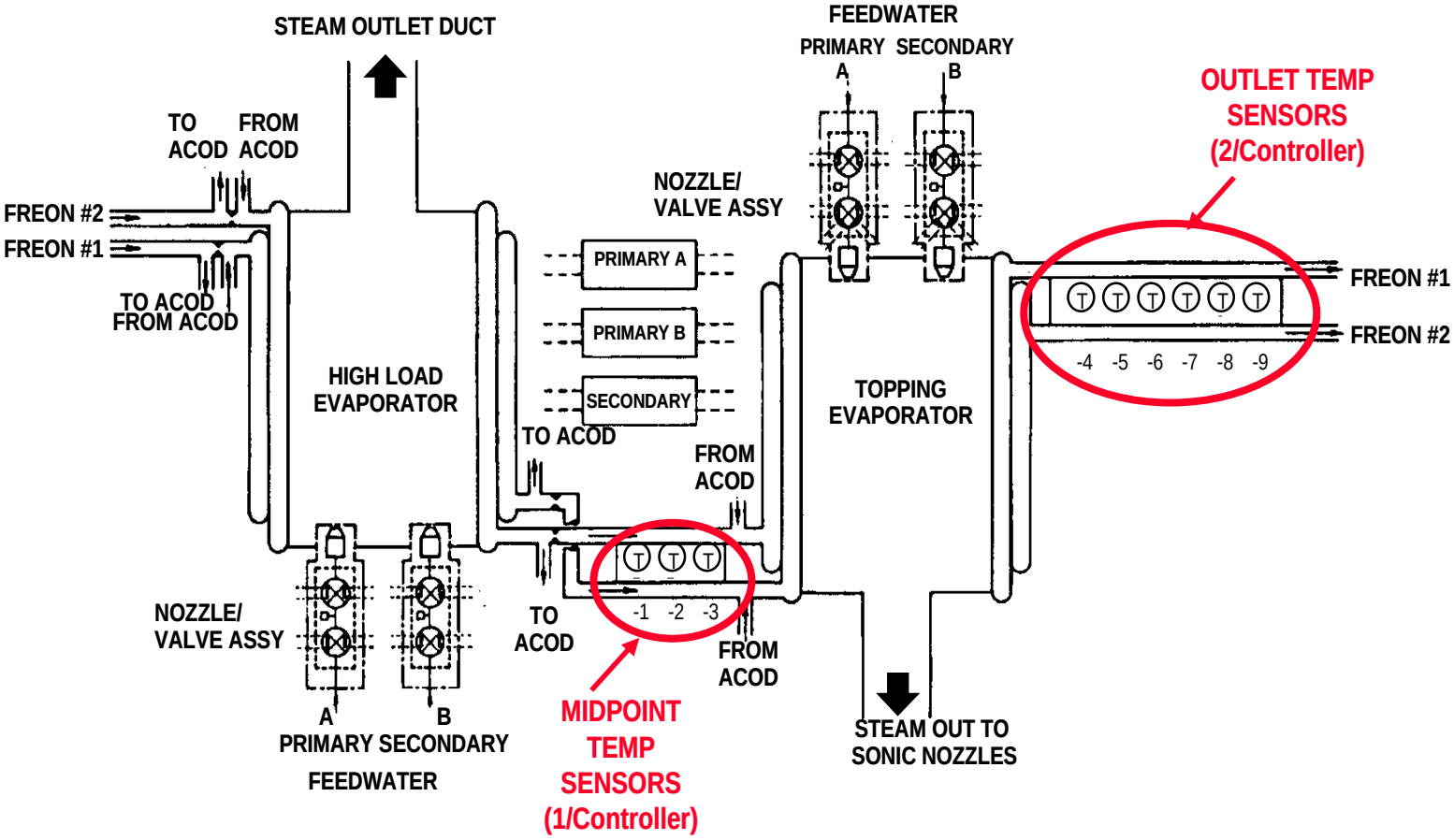
- Loss of redundant cooling in Prim B Full-Up mode

Background:

- The FES provides total vehicle cooling during ascent and entry, supplemental cooling and excess fuel cell water dump capability on-orbit
  - Cools Freon loops by evaporating water supplied from redundant systems A and B
  - Consists of two water evaporation cores (Hi-Load & Topper), three controllers (Prim A, Prim B, Secondary), midpoint and outlet temp sensors for control feed back signals
  - Utilizes 7 possible modes of operation, each involving a different combination of controllers, water supply systems, and cores
    - Prim B Full-Up utilizes both the High Load and Topping evaporator and the B controller

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

FLASH EVAPORATOR ASSEMBLY SCHEMATIC



STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion:

- Prim B Full-Up mode typically used for entry if Prim A Full-Up used for ascent, and vice versa
- During STS-92 de-orbit prep FES checkout activity, the FES shut down when operated in Prim B Full-Up
  - Following a core flush, Prim B was reactivated, but again shut down
- In total, all 7 modes of operation were run at some point during the mission, providing some data for evaluation of controllers, cores, water spray valves, and sensors
- Flight data led to initial belief that Midpoint sensor B was cause of the problem
  - Freon temperature oscillation looked similar to one produced by a degraded midpoint sensor block that has an air gap between the sensor and the block's thermal mass
  - FES midpoint sensor problems have caused shutdowns in the past

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- Post STS-92, midpoint sensor response test was performed which indicated nominal performance
  - Sensor repacking, however, was performed to increase confidence - A standard practice whenever significant oscillations or oscillation related shutdowns are observed in flight (as during STS-49, -47 and -85)
- Retest following the repacking produced same result
- Same test was run on Outlet sensors with good results
- A comparison test of B controller's Midpoint and Outlet sensors showed both reading same temperature
- A functional checkout was performed on controller B with nominal results
- Ground tests exonerated all sensors and controller B

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- In-flight data validated the integrity of the “B” hi-load and topper valves
- Cause of STS-92 shutdown is most probably due to a combination of FES aging and activation at low outlet temp (70F-75F)
  - 62F-85F is known to be a sensitive range where FES is more likely to shut down in a degraded FES
  - Low outlet temp produces low water supply flow rate, low back pressure in the core (water triple point), and consequently increases likelihood for a small amount of icing in a degraded FES
    - Icing reduces cooling efficiency and can lead to the shutdown
- OV-103 FES S/N 8 has original Hi-Load Core that was built in 1983, flown 15 flights since 1985
  - Previous S/N 7 also experienced age related/degraded performance shutdowns after about 15 flights

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Discussion: (Cont)

- PRT has recommended (including NASA DCE) FES be accepted to fly as is
- PR has been deferred for one flight
  - FES performance will be monitored during the next flight and data evaluated during the upcoming flights leading up to the next OMM for a planned replacement of S/N 8
- MOD is being requested to consider allowing FES outlet temp to go higher, near 85F, before activating FES
  - Crew to wait for a few more seconds to allow further temperature climb

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Risk Assessment:

- Minimum risk to STS-102
  - Sensors and controller were verified by test
  - In-flight data indicated nominal valve performance
  - FES Activation at a higher temperature, as a corrective action, is being evaluated by MOD
  - Core flush procedure is available to handle freezing if any
  - System redundancy and in-flight procedures exist to handle loss of Full-Up cooling mode
    - Alternate Primary and Secondary controllers are available in the event one Primary controller is completely lost
    - In the event Full-up mode is lost, each primary controller can operate in Topper mode for nominal on-orbit cooling, or re-entry cooling with power down
  - Mission is MDF with a complete loss of two primary controllers

STS-92-V-06: FES SHUT DOWN	Presenter:
	Organization/Date: Orbiter/02-27-01

Acceptable For Flight:

- Cause of STS-92 is most likely due to a combination of FES aging & activation at low temp
  - Problem can be prevented by instructing crew to activate FES at higher temp – Option being evaluated by MOD
- Observed core degradation is not expected to significantly impact FES performance prior to OMM
- System redundancy and in-flight procedures are available to handle cooling mode loss
  - Seven modes of operation available to provide FES cooling

STS-92-V-07: DSC OM2 MODULE 22 FAILURE	Presenter:
	Organization/Date: Orbiter/02-27-01

Observation:

- During STS-92, 4 measurements dropped to full scale low (-75 deg F)
  - V58T0257A - Hyd 2 LH Inboard Elevon Actuator Return Line Temp
  - V58T1701A - LMG Brake Line Temp B
  - V46T0503A - APU H2O Line Temp No. 3
  - V58T1753A - RMG Brake Line Temp D
- Indicates failure of module (card) 22 of 30 in Dedicated Signal Conditioner (DSC) OM2

Concern:

- Impact to STS-102 mission of similar DSC failure

STS-92-V-07: DSC OM2 MODULE 22 FAILURE	Presenter:
	Organization/Date: Orbiter/02-27-01

Background:

- Post-flight troubleshooting identified DSC module installed in slot 22 (MC450-0034-0022 S/N 95A) as cause of failure

Actions Taken:

- Module S/N 95A removed, S/N 92A installed
- Retest shows proper function
- S/N 95A at NSLD for TT&E and repair

STS-92-V-07: DSC OM2 MODULE 22 FAILURE	Presenter:
	Organization/Date: Orbiter/02-27-01

Risk Assessment:

- Redundant measurements routed to separate DSCs
- If not possible, route is to different modules in the same DSC
- Max loss for a single DSC module failure is 8 measurements
- Loss of single, non-redundant measurements can scrub launch
- Loss of single, non-redundant measurements will not result in MDF or next PLS

Acceptable for Flight:

- Instrumentation channelization philosophy prevents loss of redundant measurements due to a single DSC failure
- DSC module failure has no impact on DSC function/operation
  - No other measurements routed through the DSC are affected
- Failure history shows DSC has few failures
  - This was the first flight failure of an entire DSC module